

## **Meeting report – WMO Task Team on Definition of Extreme Weather and Climate Events, Marrakech, Morocco, 24-26 February 2014**

The Task Team on the Definition of Extreme Weather and Climate Events (TT-DEWCE) held its second meeting of the current CCI intersession period in Marrakesh, Morocco from 24-26 February 2014, hosted by the Direction de la Météorologie Nationale, Morocco. The meeting was opened with a half-day seminar at the Cadi Ayyad University of Marrakech, before the working part of the meeting proceeded (The agenda of the seminar is in Annex A).

### Introduction – TT-DEWCE terms of reference, objectives and membership

The terms of reference of TT-DEWCE are as follows:

1. Considering the existing work and studies, including by WMO communities and others which relate to climate extreme events, their definitions, geographical distribution, space and time scales, intensity, etc;
2. Taking into account the gaps in and the need for developing common definitions related to climate extreme events with particular focus on cold waves, heat waves and severe precipitation and storms events (not including those related to tropical cyclones);
3. Provide guidance to the Members on methodologies and standards for defining extreme weather and climate events and assessing their attribution and return periods, and advise on adequate computational tool for the assessment;
4. Provide an advise on developing an inter-operable data base for monitoring climate extreme events with focus on regional and national levels;
5. Liaise with other commissions, programs, co-sponsored programs and regional and international projects and agencies to develop linkages and partnership on this subject;
6. Should software be deemed appropriate, either create the software or recommend that such software be created;
7. Report to OPACE-2 co-chairs; and
8. Task team lead to inform the OPACE co-chairs that the task is finished and that the team can be dissolved.

Particular areas of interest of the TT, within these terms of reference, are the availability of information on extreme weather and climate events in close to real time, and developing methods of defining extreme events which have boundaries which are flexible in both time and space, as an extension from existing work (e.g. the indices developed by ETCCDI) based on events on a specific day at a specific station.

The meeting was attended by Fumin Ren (China; chair), Boris Sherstyukov (Russia), Andreas Walter (Germany), Jose Luis Stella (Argentina) and Blair Trewin (Australia). Maya Koerber (Germany) also attended in support of the agenda item on databases. Also attending were the OPACE-2 co-chairs, Fatima Driouech (Morocco) and Manola Brunet (Spain), as well as Omar Baddour from the WMO office. Unfortunately, team members Randy Cervený (USA) and D.R. Pattanaik (India; co-chair) were unable to attend the meeting but both had substantial involvement in the preparation of the meeting documents.

## Meeting agenda

The meeting opened with presentations by Omar Baddour and Manola Brunet on WMO preparations for the upcoming session of the Commission for Climatology, and progress in the various OPACE areas during the current CCI session. During this session, the proposed structure of Expert Teams and Task Teams for the forthcoming CCI session was also outlined. There was also a presentation by Jose Luis Stella on the implementation of an operational monitoring system for extreme temperatures (including heat and cold waves) in Argentina.

The meeting then moved on to reviewing and discussing, in turn, reports for each of the five current TT-DEWCE tasks (see below), following presentations on each task. Under the original agenda it was proposed to revise the task reports at the meeting, but during the meeting it was felt to be more productive to develop a set of recommendations relating to the tasks, especially given the need to have some recommendations ready to go to the WMO EC in June. Revision of the task reports will now be carried out post-meeting.

The final day of the meeting was largely devoted to discussing draft recommendations which had been developed overnight by a number of meeting attendees. These were consolidated into the set of recommendations listed later in this report. The final part of the meeting also included a discussion of the future of the Task Team, determining who was responsible for each of the action items, and discussion of plans for a revised review paper on regional extreme events.

### Major current TT-DEWCE tasks

The initial set of TT-DEWCE tasks was developed at the TT's first meeting, which was held in Spain in November 2011. These tasks were:

- Task 1.** Review the existing work and studies on extreme weather and climate events.
- Task 2.** Evaluate the gaps in and the need for developing common definitions of extreme weather and climate events.
- Task 3A.** Provide guidance on methodologies and standards for defining regional extreme weather and climate events, with an advice on adequate computational tools for doing this.
- Task 3B.** Provide advice on developing an inter-operable data base for regional extreme weather and climate events.
- Task 4.** Provide a WMO portal which links to national products and reports on extreme weather and climate events.

Reports for each of the tasks were tabled and subject to initial discussion well ahead of the meeting. In particular, a detailed report was presented on the way in which the RA VI Regional Climate Centre's database of extreme events operated, and whether the structure of this had the potential to be scaled globally. If that were to be feasible, it would fill a major information gap, as it contains information on the impacts of extreme events, something which is typically very difficult to obtain consistent, authoritative information about.

The OITREE technique developed in China (Task 3A) was viewed by the meeting to have considerable potential as a methodology for defining extreme events whose boundaries are flexible in both time and space. It was, however, felt that the technique requires further testing in countries other than China before final endorsement as a recommended method for general global use. It will also be important to develop software which can be used to implement the method but

is not dependent on high-level computing capacity which may not be available to smaller NMHSs or those in less developed countries.

#### Areas requiring further discussion

The major area which the meeting failed to reach a consensus on was the recommendation of a specific index for defining heatwaves (and extended cold spells). There are a large number of indices which have been defined in the scientific literature or are in operational use by one or more Members. Among the issues to be considered are the minimum length of time to be considered, which variables should be considered (maximum temperature, minimum temperature, humidity, a combination of these, or something else), and whether any index should be absolute or also consider anomalously warm/cold spells at times of year other than summer (heat)/winter (cold).

It was felt that, prior to recommending one or more indices, it would be necessary to carry out an evaluation of existing indices in use, considering factors such as global usefulness of an index, its relationship to impacts, and its ease of calculation in near real time. As a necessary first step to this evaluation, the meeting recommended carrying out a survey of indices in current use or in the literature.

Drought is another area which requires further consideration. Drought is a phenomenon which is potentially within the mandate of the TT under its current terms of reference. It is, however, an area which is also being actively considered under other WMO channels. The meeting declined to make any specific recommendations about drought as it had only limited information about other work being carried out on drought under the WMO structure. Further information was subsequently obtained, which resulted in a post-meeting recommendation for the use of the Standardised Precipitation Index (SPI) (Recommendation 1).

If a database of extreme events is to be made operational (Task 3B), guidance will need to be given as to consistent criteria for inclusion in such a database. As the database would potentially encompass a very wide range of phenomena, many of which do not have long, high-quality supporting time series of instrumental data, it was considered to be difficult to set a specific criterion. A suggestion of a one-in-10 year event (to be defined by the contributing country) was mentioned in discussion but did not reach the stage of a formal recommendation at this point in time.

#### Linkages with other WMO bodies

The Task Team has clear linkages with a number of other WMO groups, especially the Expert Team on Climate Change Detection and Indices (ETCCDI) and the Task Team on National Climate Monitoring Products (TT-NCMP). In particular, the TT believes that, given the work which has already been done in ETCCDI on indices, that, to the extent possible, any indices recommended by the TT should be based on those already developed by ETCCDI. There is also a clear case for common development of software; ETCCDI already has a software platform and there would appear to be little value in duplicating that. A clear overlap with TT-NCMP is the proposed portal (Task 4), as many of the events of interest to TT-DEWCE are documented as part of routine national or regional monitoring products.

Links with other WMO bodies will also be important in specific areas; for example, CAgM and CHy have a strong interest in indices of extreme precipitation (high or low), while CBS will have a role in any specific operational procedures which are recommended as a result of the TT's work

## Recommendations and further discussion

The general view of the meeting was that the TT's recommendations should concentrate on a relatively small set of events, to maximise the likelihood of uptake by a reasonable proportion of Members in the early stages of operation. This can be viewed as a first-stage project with the potential for expansion in future years.

The following recommendations were made by the meeting:

### 1. *Basic indices for reporting*

- That percentile-based indices are recommended for global reporting.
- As a first stage, members be encouraged to use the following indices as a basis for monthly reporting:
  - (1) Number of days with Tx above the 90<sup>th</sup> percentile
  - (2) Number of days with Tn below the 10<sup>th</sup> percentile
  - (3) Number of days with precipitation above the 95<sup>th</sup> percentile (subject to consultation with ETCCDI)
  - (4) Standardised Precipitation Index (SPI) for the last 12 months.
- That these indices be defined as per ETCCDI definitions (i.e. with seasonally varying thresholds), but members be advised that they may wish to report only in months which they consider relevant (e.g. high temperatures in summer but not in winter)
- That this would not preclude members reporting on other indices for their own purposes.

(It should be noted that the ICA&D platform, coordinated by KNMI (Netherlands), may provide a suitable platform for much of this reporting. The March 2014 ETCCDI meeting endorsed, in principle, the ultimate aim of extending the ICA&D platform globally. At present, it covers Europe, southeast Asia, and parts of South America and Africa, although only subsets of these regions supply data in near real-time).

### 2. *Multi-day indices*

- That members be encouraged to report, monthly or seasonally, on the maximum number of consecutive days with Tx above the 90<sup>th</sup> percentile, and Tn below the 10<sup>th</sup> percentile.
- That the definition of how many consecutive days constitutes a 'heatwave' be left to members for now.
- That the TT works with ETCCDI and other relevant experts in the field to further develop suitable definitions for heatwaves, noting that indices for defining heatwaves are still an issue of active scientific debate, with specific issues including the length of event to consider, and whether or not seasonal variation should be considered.
- That a survey be developed to assess countries current practices in defining Heat waves, Cold waves, and related operational monitoring. The survey would complement the current assessment made by the TT.
- Considering also the current definitions and methodologies for calculating extreme weather and climate events, such as heat waves and cold waves, is dependent on the final application of such extremes (e.g. for climate change detection and attribution studies like the WSDI and CDSI indices formulated by the ETCCDI as proxies for HW and CW; sector specific applications such as agricultural, hydrological, forest or risk management; or for

weather and climate monitoring purposes and early warning systems and/or climate watches outlooks), the TT-DEWCE recommends to explore along with the relevant working groups of WCRP (e.g. CLIVAR), WMO bodies (e.g. CBS) and scientific community new indices that take into account not only the duration and intensity of these events, but also their scaled severity.

3. *Software*

- That the TT works with ETCCDI to make any modifications necessary to the Rclimdex software to make it suitable for operational use for the indices defined in (1) and (2).

4. *Extreme seasonal rainfall*

- That the TT works with CAgM, CHy and other relevant bodies to define suitable indices for defining extreme high and low seasonal rainfall (beyond the 12-month SPI recommended above).

5. *Regional extreme events*

- That the TT supports, in principle, the adoption of the OITREE method as a tool for defining and quantifying regional extreme events, subject to further testing.
- That members be sought to undertake testing of OITREE in their own countries, with the aim of sampling a broad range of climates.
- That work be undertaken to make it possible to implement OITREE in PC-based formats used by smaller or less developed NMHSs.
- That an expert workshop be run (possibly in early 2015) on OITREE suitability for implementation in other regions.

6. *Development of database for extreme events and impacts*

- That work be undertaken to investigate the feasibility of extending the RA VI-RCC extreme events database structure globally.
- That, once such a database is established, that a mechanism be established for members to contribute information to that database.
- That, for elements which do not have well-defined indices (e.g. severe storms, severe winds), the general criteria for inclusion would be that the event be a 1 in 10 year event in a location or region.

7. *Development of WMO portal for information on extreme events*

- That terms of reference for a WMO portal for information on extreme events be drafted, based on the first-stage proposal in the Task 4 report tabled at the meeting.
- That it be recommended to EC that volunteers be sought to host such a portal on the basis of these terms of reference.

8. *Engagement with other bodies*

- That joint work be carried out with CBS and WCRP on finalizing formal definitions based on TT suggestions, and address with CBS possible implications on related operational

and standardisation issues that would need to be reflected in the WMO regulatory mechanisms and references.

#### 9. *Definition of extreme events*

- Based on analyses which show that generally extreme events have a certain spatial scale and time scale, it is recommended that a definition of extreme events needs to consider not only the time scale (such as year, season, month, day or sub-day), but also spatial scale (such as a location or a region). This indicates a definition of extreme events as ---- For a weather and climate phenomenon with a certain spatial scale and time scale, if there is an indicator (variable or index) that can represent the phenomenon and when it meets the statistical extreme standards ---- that means the value of the indicator being above (or below) the upper (or lower) threshold in the tail of its probability distribution function, then the phenomenon can be defined as an extreme weather and climate event.

#### 10. *Normals*

- In accordance with expected WMO decisions on climate normals, it is recommended that products use the most recently updated WMO reference period (e.g. currently 1981-2010) when their final application is mainly operational and sector oriented and the WMO Standard Climate Normal (e.g. 1961-1990) when their final application is assessing climate change.

#### 11. *New indices*

- We recommend the use of the newly defined S95pTOT, which complements and improve the R95pTOT ETCCDI index, and enhances it since it is more representative of changes in the distributional shape, and will work with ETCCDI in the development and implementation of new and improved indices more generally.

### Acknowledgements

The Task Team gratefully acknowledges the role of the Direction de la Météorologie Nationale, Morocco in supporting the organisation of the meeting. In particular, the TT gives thanks to:

- Mr. Abdalah Mokssit for agreeing to host the organization of the meeting and for putting at the disposal of the TT all the needed facilities.
- Dr Fatima Driouech as focal point of the organising committee
- Mr Abdel Haq Haliba, the head of logistical aspects team
- Ms Houda Bejnelloun, assistant and member of the organizing committee

## Appendix A – action items

The following action items were put forward as a result of the meeting:

- Report of TT meeting: (Blair Trewin; first draft 14 March)
- TOR of the portal: (Blair Trewin; end of March)
- Guidance document on use of indices for reporting on national level, two pages: (Fatima Driouech, April)
- Report to TT NCMP, ETCCDI, ET-CSRI, DRR focal point on the conclusions of this meeting: (Fatima Driouech, Blair Trewin, Manola Brunet)
- Draft a Template Survey on heat waves, cold waves, High precipitation and dry spells definitions and current practices to the Members: (Blair Trewin; 14 March 2014)
- Technical document based on the new organisation of the report: (All (lead Blair Trewin and Fumin Ren), 1<sup>st</sup> draft in June, circulation to other groups afterwards, zero draft be circulated internally before the first draft).
- EC 66: OITREE to be recommended in the EC document to call for testing it (Omar Baddour to lead).
- CAgm, Chy, Link on special investigation: (Omar Baddour)
- Put a text for CBS-ext, on seamless weather-climate approach and implication for operational arrangements within CBS: (Omar Baddour)
- Prospect on line participation heat wave workshop in Australia 5-6 May 2014 and report back to the TT: (Blair Trewin)
- Revise and Publish the review paper, all TT members: (Fumin leading)

## Appendix B – agenda of pre-meeting seminar

The Meteorological Directorate of Morocco (DMN) and Cadi Ayyad University of Marrakesh (UCAM) and the Joint International Laboratory TREMA in partnership with the WMO Commission for Climatology organized a Seminar on: “Weather and climate extremes: *evolution and change and international efforts for their identification and monitoring*” on 24 February 2014, 9:00-13:00, UCAM, Marrakesh, Morocco

### **Agenda**

Chair of the Session: Manola Brunet

09:00-09:30- Welcome addresses: UCAM, WMO, DMN

09:30-09:55- A summary of the main IPCC-WGI report (AR5) outputs with focus on extremes (A. Mokssit)

09:55-10:15- The observed and future evolutions of extremes with a focus on North Africa (F. Driouech)

10:15-10:40- A Review of the existing work and studies on extreme weather and climate events: the importance of having common definitions (Blair Trewin)

10:40-11:00- Coffee break

Chair of the Session: Abdalah Mokssit

11:00-11:25- TT-DEWCE works and achievements (Fumin Ren)

11:25-11:50- The WMO/MEDARE Initiative and the development of high-quality climate time-series (Manola Brunet)

11:50-12:15- The role and efforts done by WMO and CCI for a better monitoring and prediction of Extreme events and climate extremes (Blair Trewin)

12:15-12:45- Discussions

### Appendix C

List of participants:

<b>Name</b>	<b>Country</b>	<b>Institution</b>
Prof Manola Brunet-India (OPACE II Co Chair)	Spain	Centre for Climate Change (C3), University Rovira i Virgili
Dr Fatima Driouech (OPACE II Co-Chair)	Morocco	Direction de la Météorologie Nationale
Maya Körber (invited expert)	Germany	Deutscher Wetterdienst
Dr Fumin Ren	China	State key Laboratory of Severe Weather (LaSW) Chinese Academy of Meteorological Sciences (CAMS)
Boris Sherstyukov	Russia	Russian Federal Service for Hydrometeorology and Environmental Monitoring
José Luis Stella (associated expert)	Argentina	Servicio Meteorológico Nacional
Dr Blair Trewin	Australia	Bureau of Meteorology
Dr Andreas Walter	Germany	Deutscher Wetterdienst
<b>WMO representative</b>		
Omar Baddour	Switzerland	World Meteorological Organization